



# **Armed Forces College of Medicine AFCM**



## **DEVELOPMENT OF GIT 2**

**Development of Duodenum, Liver]  
[& Pancreas**

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**Embryology**

## INTENDED LEARNING OBJECTIVES (ILO)



**-At the end of this lecture, students should be able to:**

**i. List the sources and steps of development of the duodenum.**

**ii. Describe the sources of various components and steps of development of the liver & biliary system.**

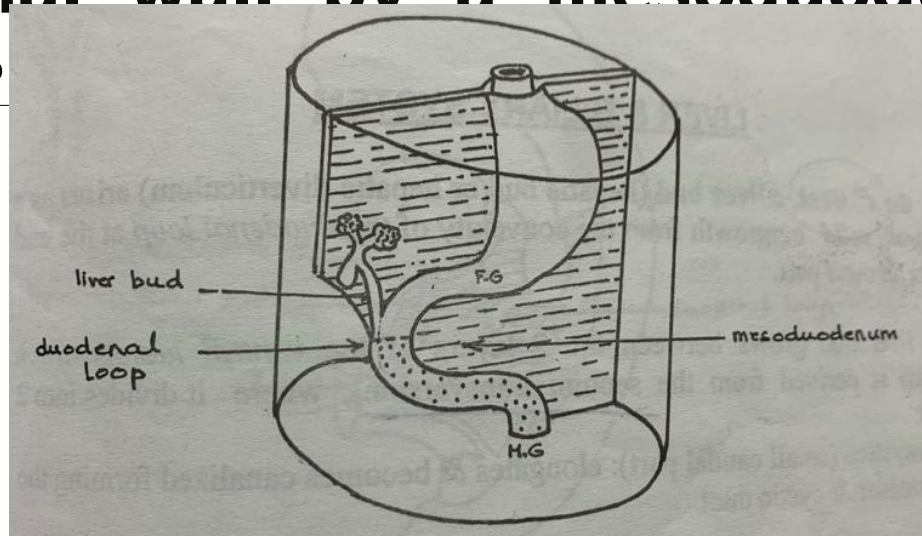
**iii. Discuss the sources and steps of development of the pancreas.**

**iv. Explain the congenital anomalies of the duodenum, liver & biliary system and the**

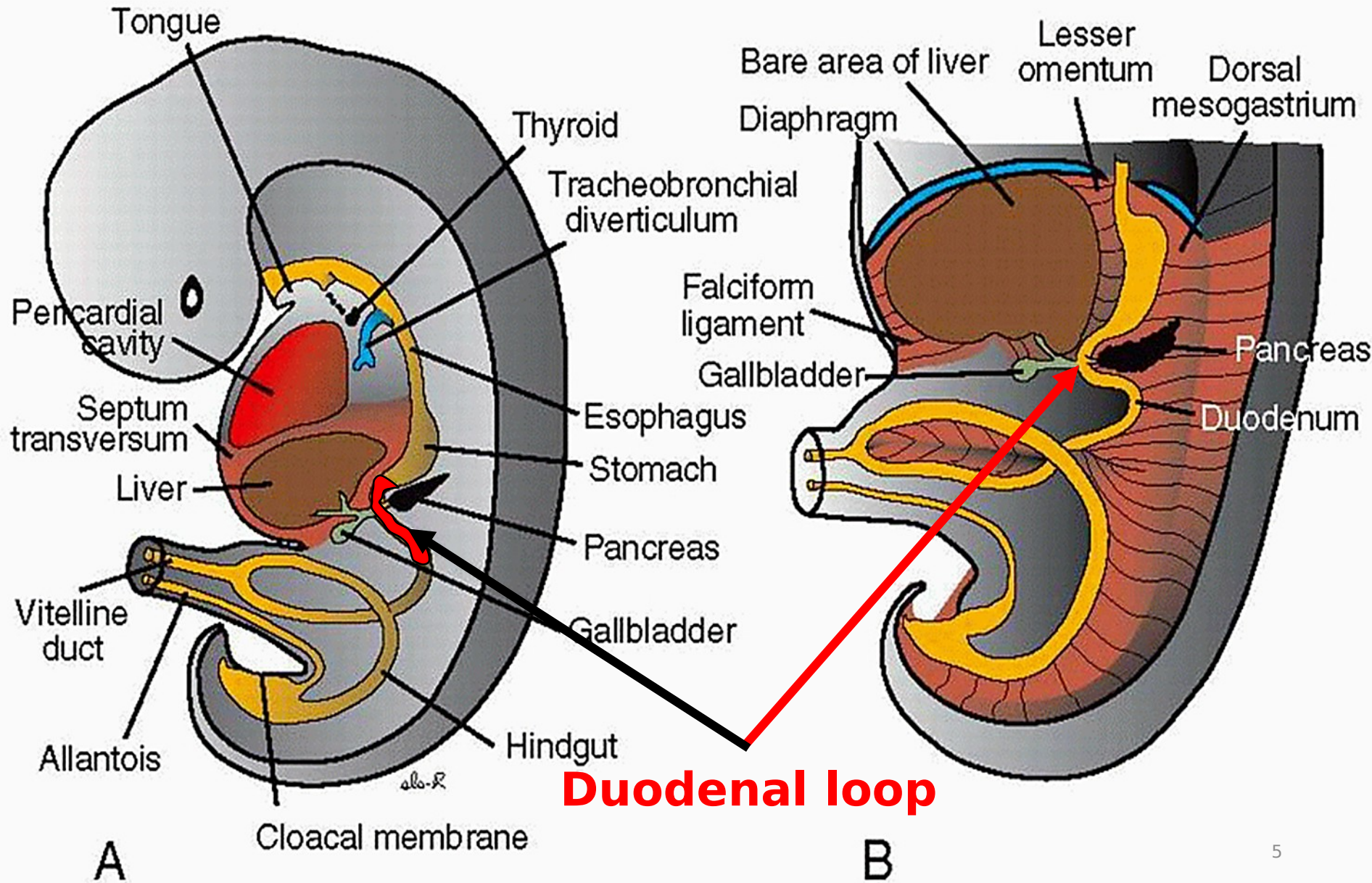
## ♣ Development of the duodenum:

- The duodenum develops from a U-shaped **duodenal loop** which is convex forwards.
- The upper  $\frac{1}{2}$  loop develops from the foregut & the lower  $\frac{1}{2}$  from the midgut.
- *Just above the junction of both parts, a **liver bud** arises from the convexity of the duodenal loop.*

.The whole loop is connected to the posterior abdominal wall by a mesoduodenum. Its 1<sup>st</sup> inch has pancreas.

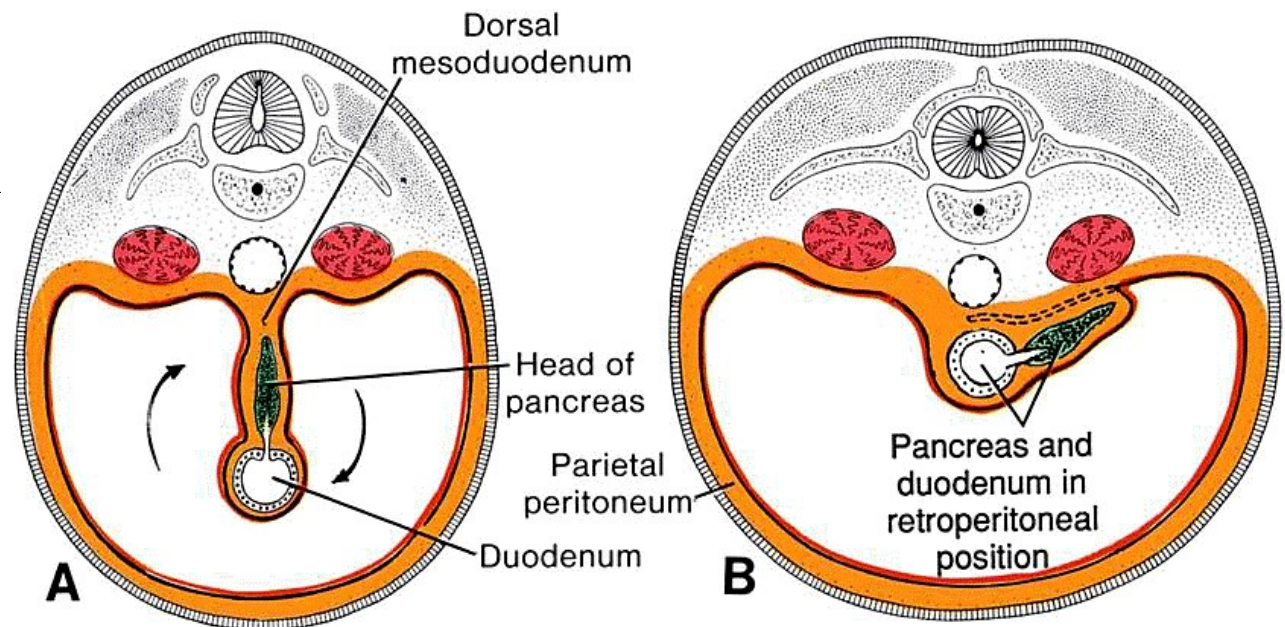


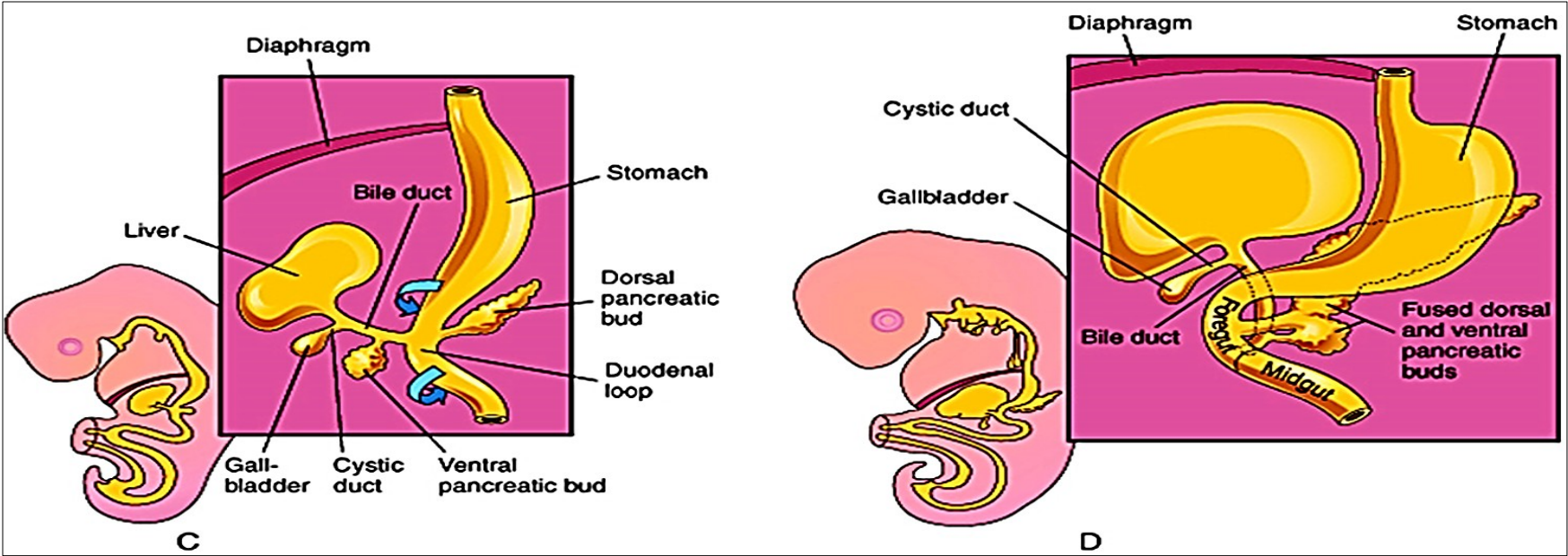
# Development of the duodenum



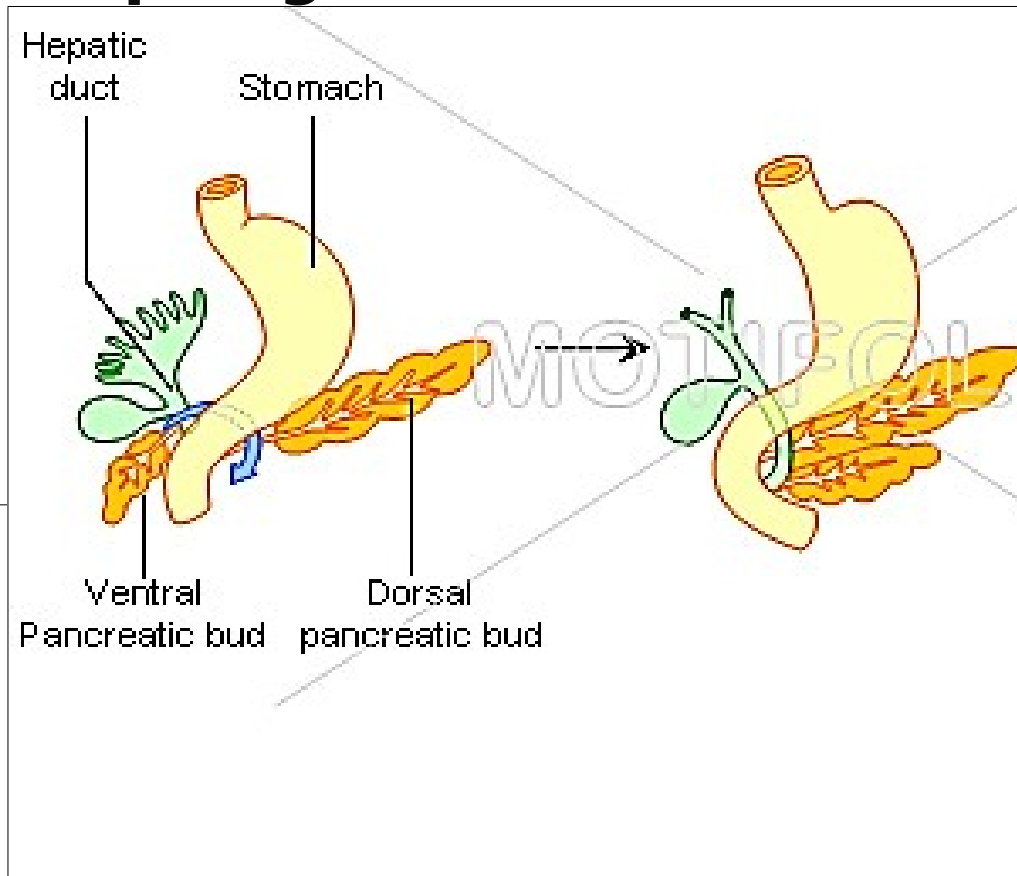


- The duodenal loop **rotates** 90° to the right until it rests on the peritoneum of posterior abdominal wall & fuses with it.
- Fused peritoneal surfaces become absorbed thus duodenum becomes retroperitoneal except its 1<sup>st</sup> inch.
- .The lumen becomes obliterated temporarily then recanalized.





**-As the duodenal loop rotates, the opening of the liver bud (the future opening of the common bile duct) is shifted to the posteromedial aspect of the duodenal loop due to unequal growth of its walls.**





Note  
that ...



**.As the duodenum develops from both the foregut & the midgut, it is vascularized by branches of both the coeliac & the superior mesenteric arteries.**

## ● **Anomalies of duodenum:**

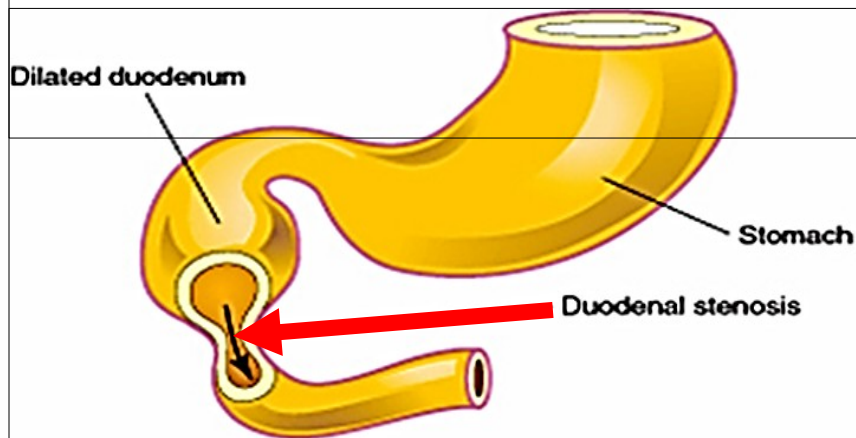
### **1. Duodenal stenosis:**

**.It results from incomplete recanalization.**

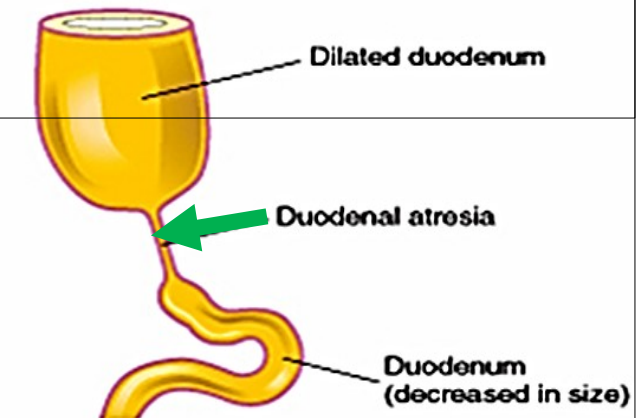
### **2. Duodenal atresia:**

**-Due to complete failure of recanalization of the duodenum.**

**.Duodenal atresia → Polyhydramnios.**

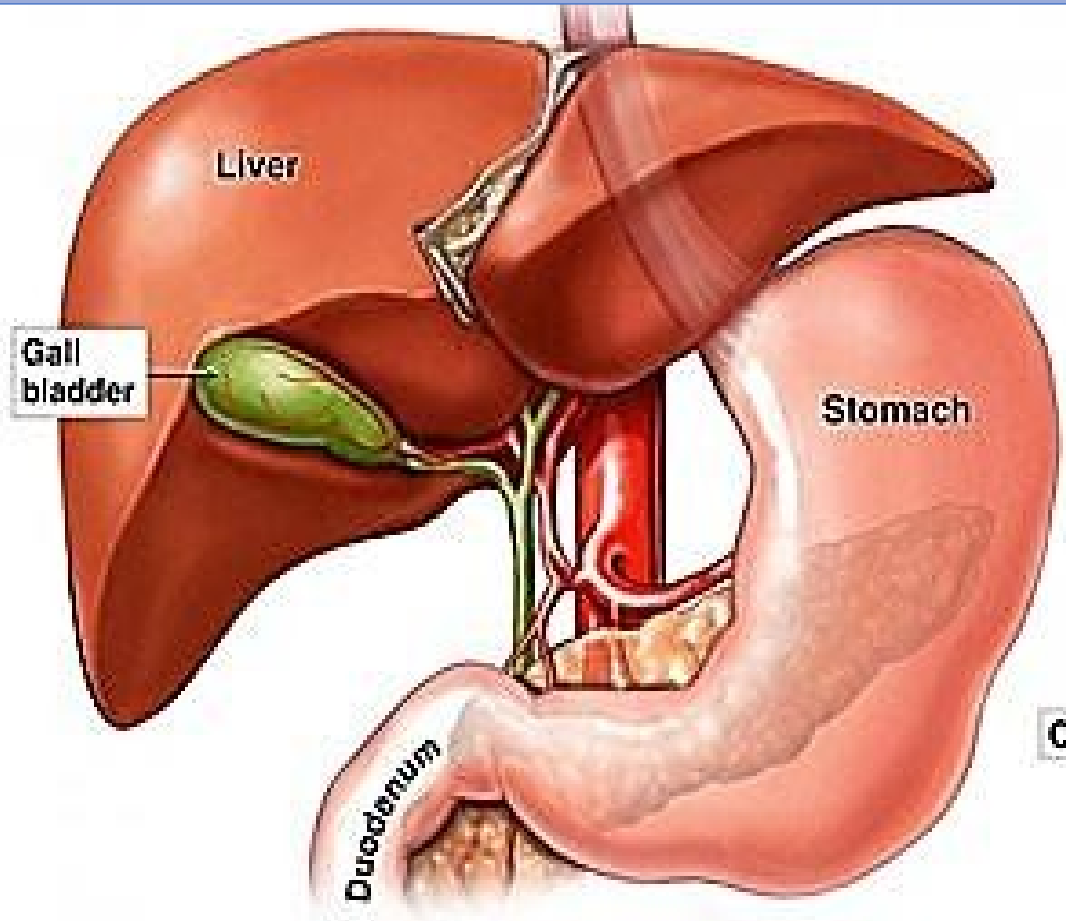


**Duodenal stenosis**



**B Duodenal atresia**

# Development of liver and biliary system



Anterior view

## Development of liver & biliary system:

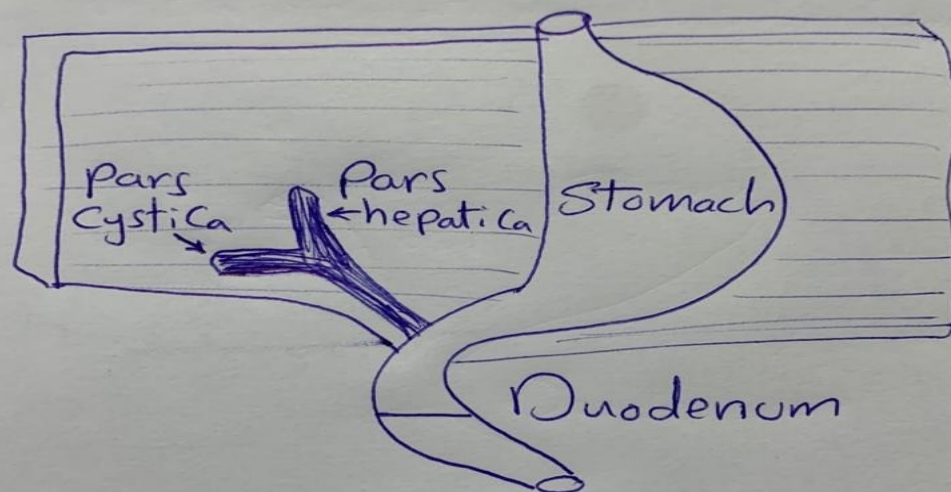
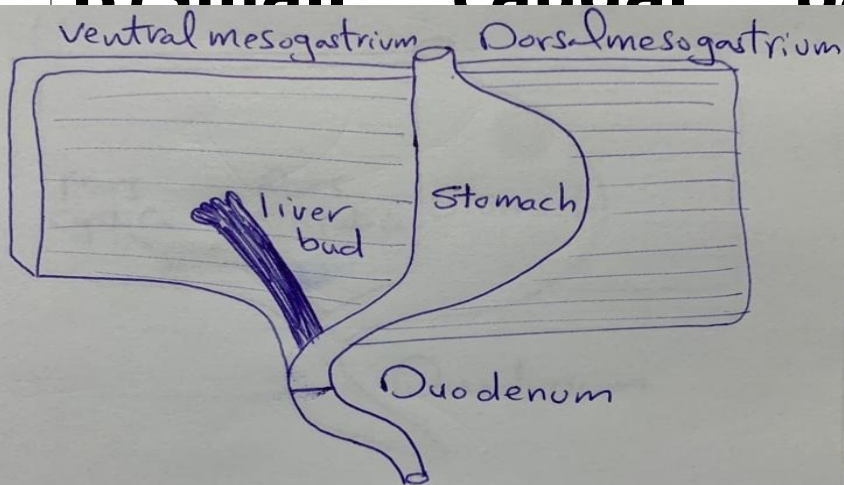
-By 4<sup>th</sup> week, a liver bud (**hepatic diverticulum**) arises as an outgrowth from the convexity of the duodenal loop at the end of its foregut part.

-Liver bud grows between the 2 layers of ventral mesogastrium (which is derived from the septum transversum).

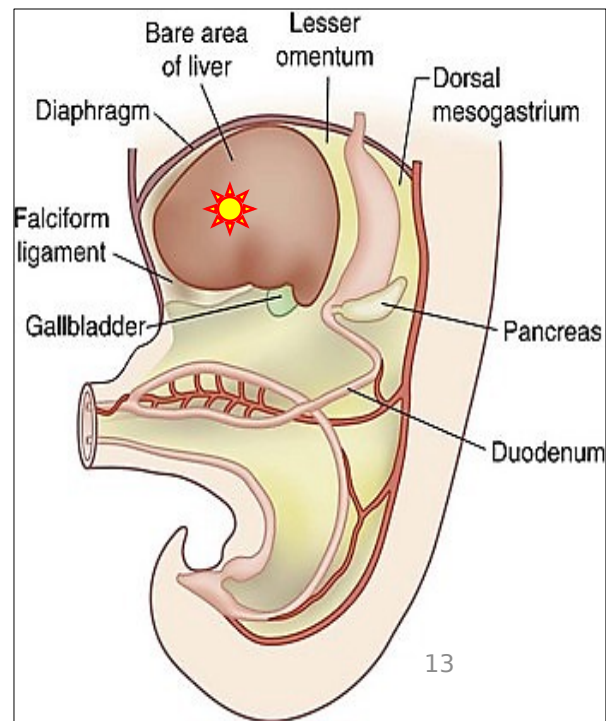
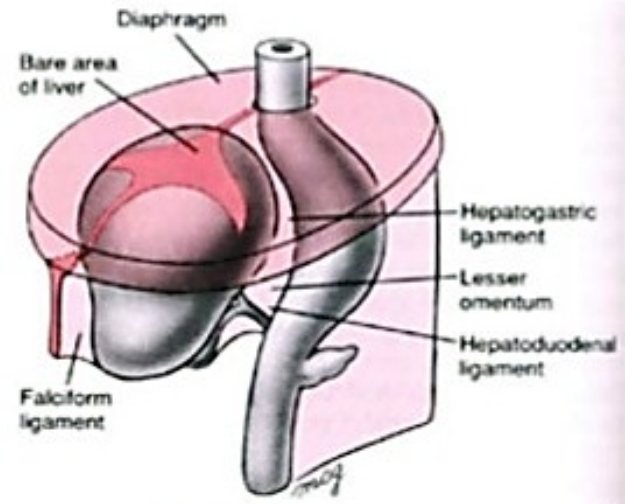
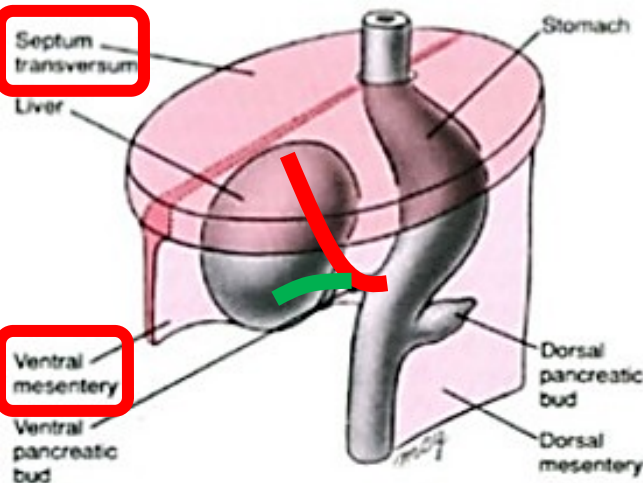
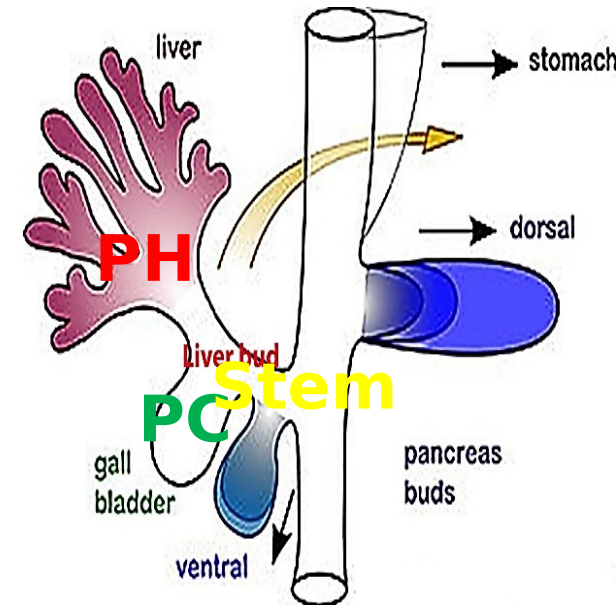
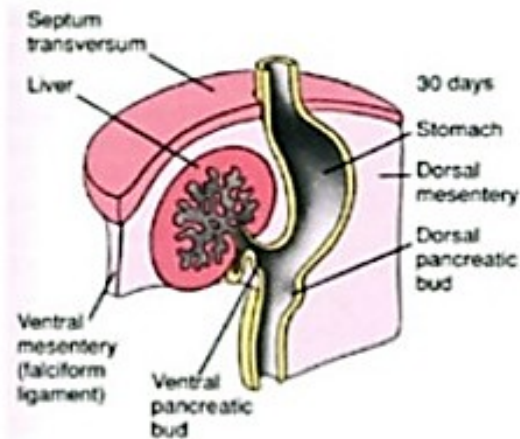
-Liver bud divides into 2 parts:

A) Large cranial part (**Pars hepatica**) → Primordium of the liver.

B) Small caudal part (**Pars cystica**) →

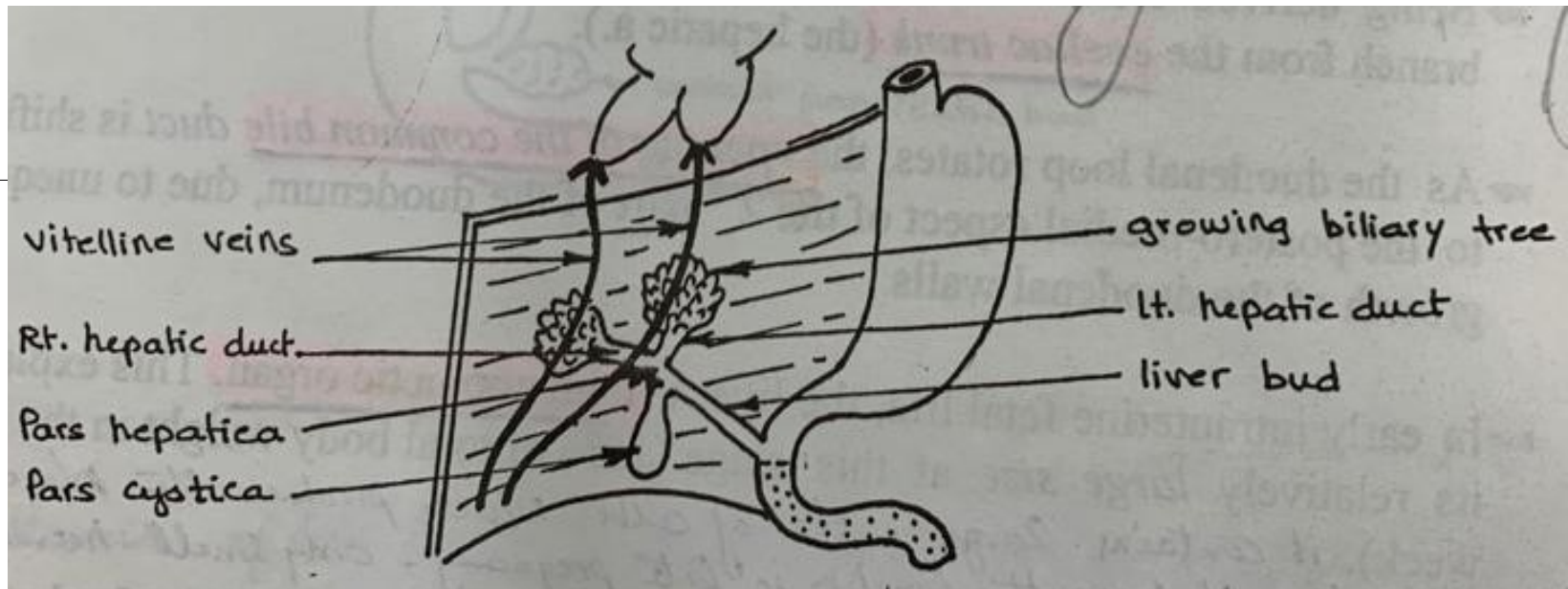


# Liver development





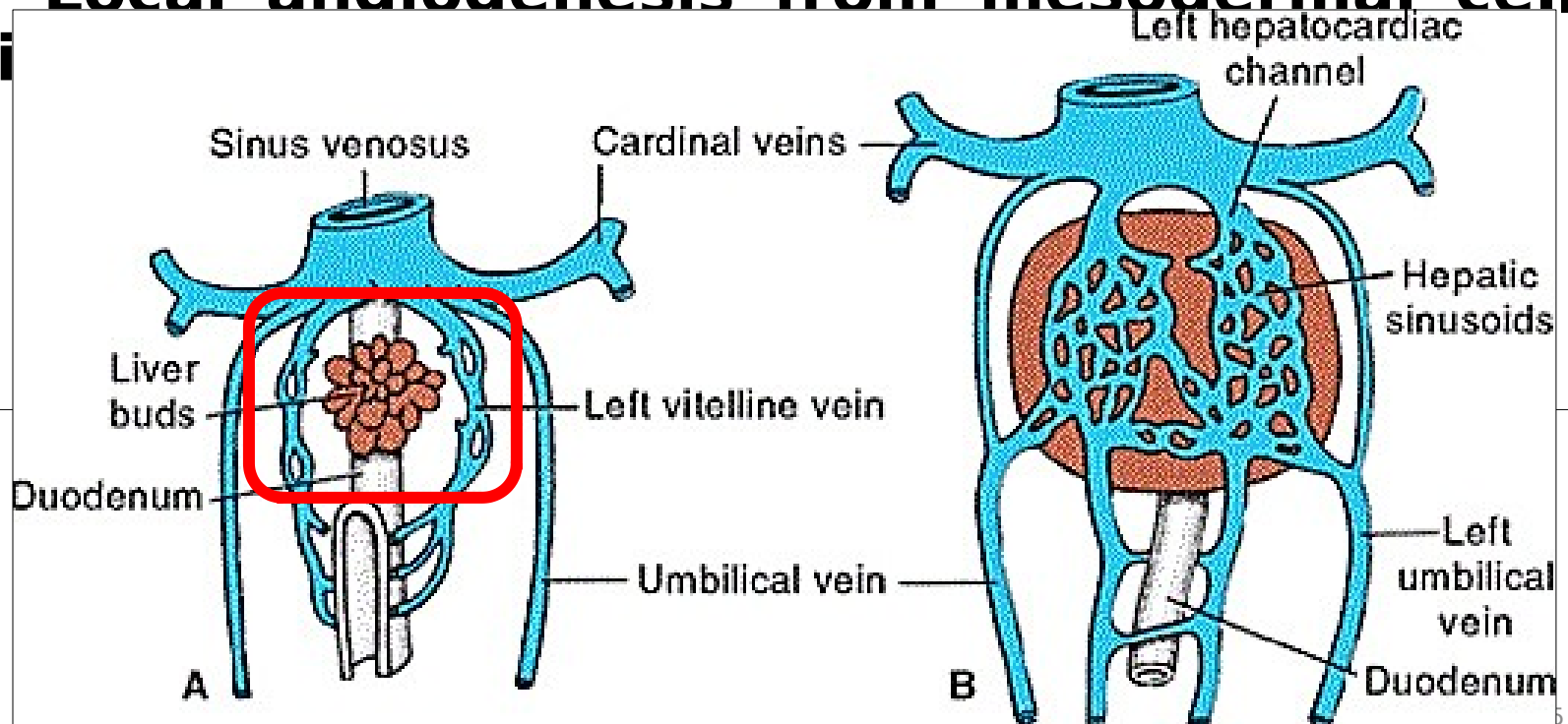
- **Pars cystica** elongates & becomes canalized forming the gall bladder & cystic duct.
- **Pars hepatica**: Divides into right & left hepatic ducts which become canalized & break repeatedly:
- . Proximal branches  $\Rightarrow$  Intrahepatic biliary tree.
- . Terminal branches show thickening of their lining cells  $\Rightarrow$  Cords of hepatocytes.



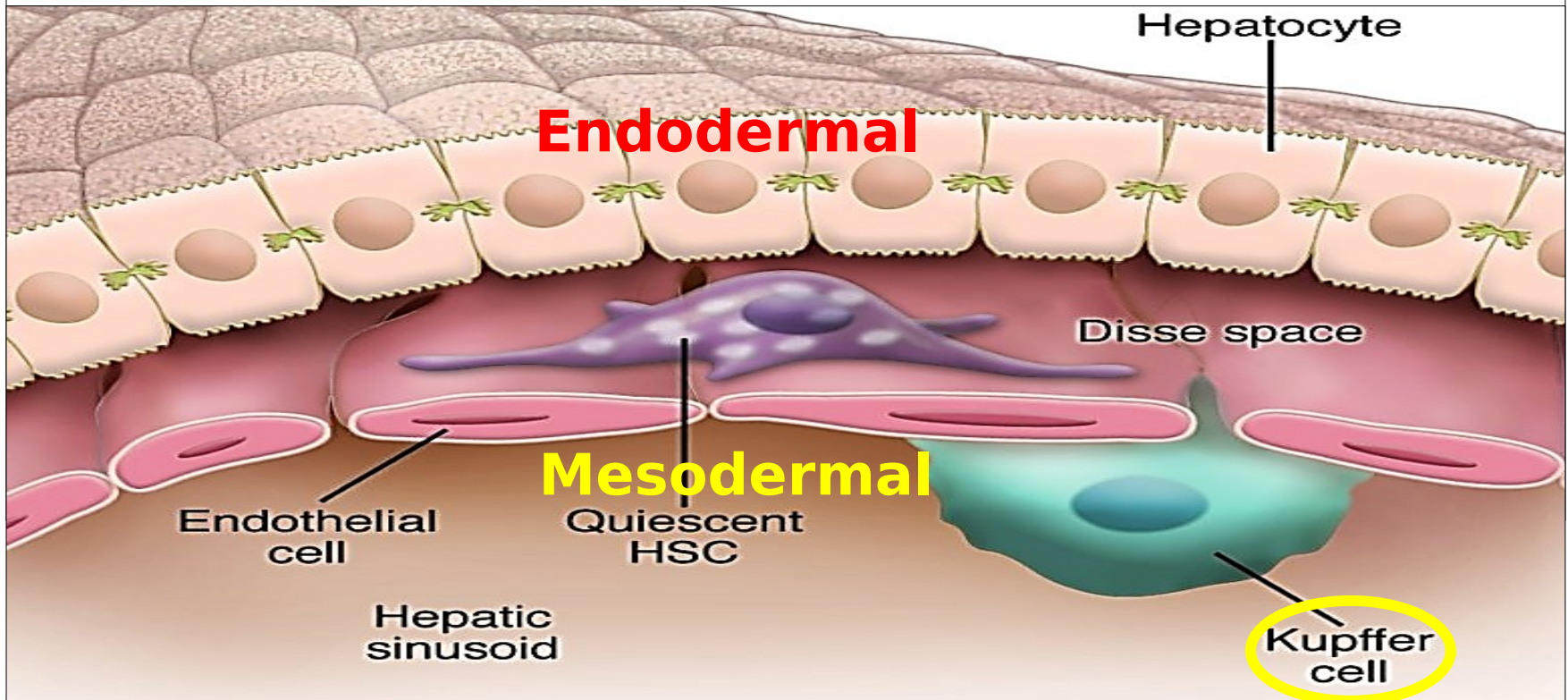
**.The **blood sinusoids** of the liver develop from 2 sources:**

**1. Breaking down of parts of **vitelline veins** within the septum transversum by the growing biliary tree.**

**2. Local angiogenesis from mesodermal cells**



**.The fibrous capsule of the liver, stroma & Von-Kupffer cells are also mesodermal in origin (derived from the septum transversum).**



# summary

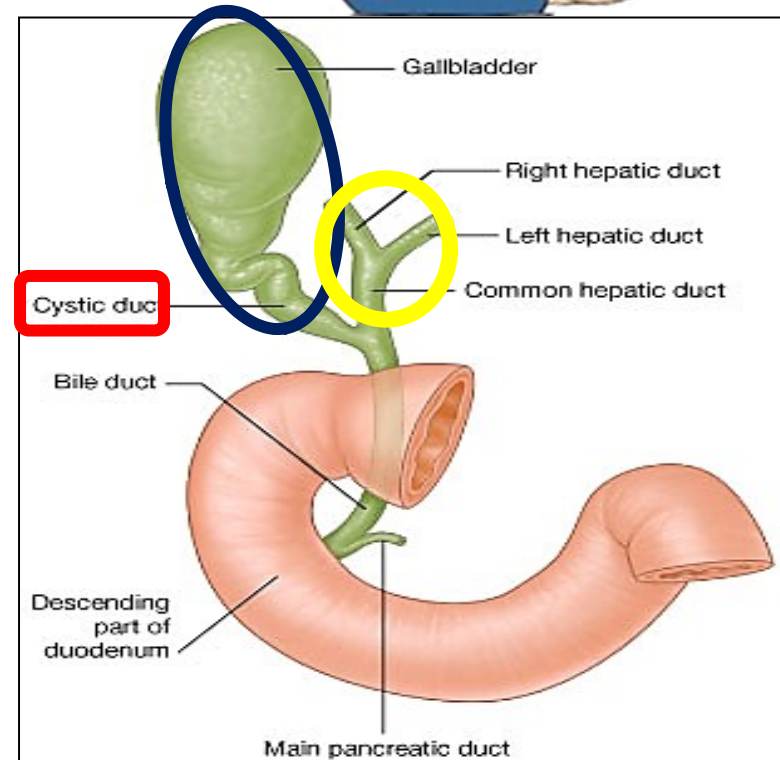


**-Liver & extrahepatic biliary passages develop from the **liver bud** as follows:**

**.Stem of liver bud  $\Rightarrow$  Bile duct.**

**.Pars cystica  $\Rightarrow$  Gall bladder & cystic duct.**

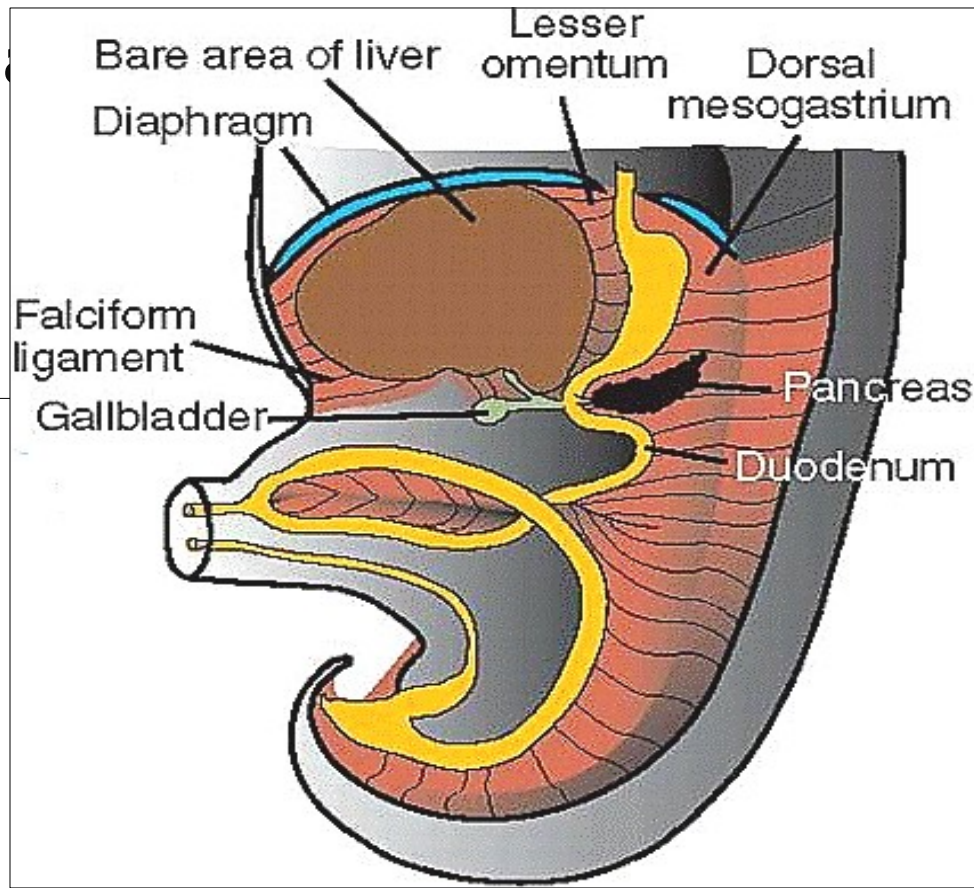
**.Pars hepatica  $\Rightarrow$  Common hepatic, right & left hepatic ducts -  
Intrahepatic bile ductules - Hepatocytes.**





-The ventral mesogastrium becomes differentiated, by the growing liver, into **3 parts**:

1. Lesser omentum: Between liver & stomach.
2. Falciform ligament: Between liver & anterior abdominal wall.
3. Coronoid ligament: Between the liver & duodenum.





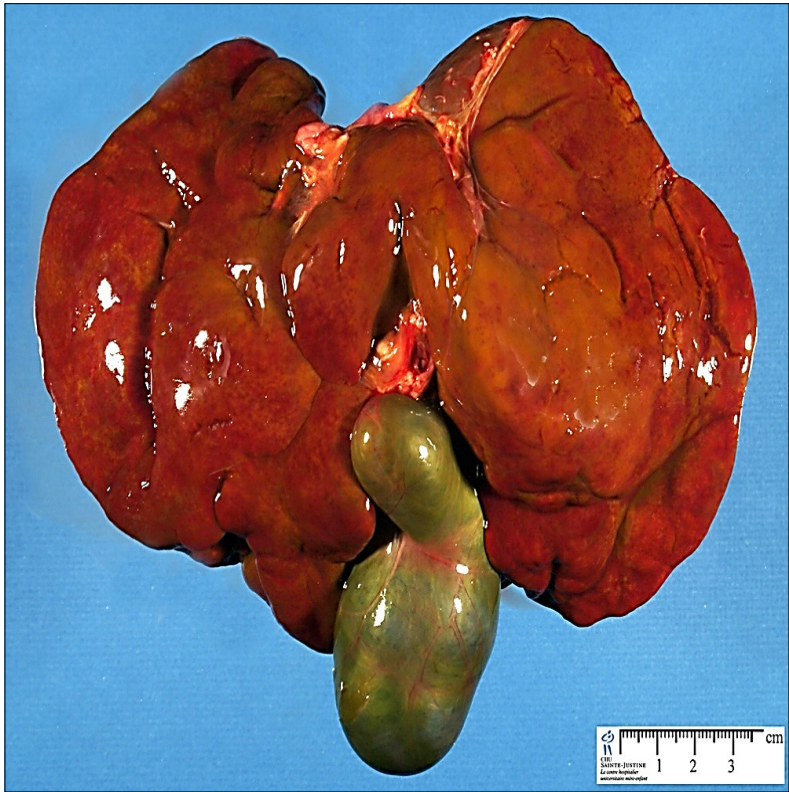
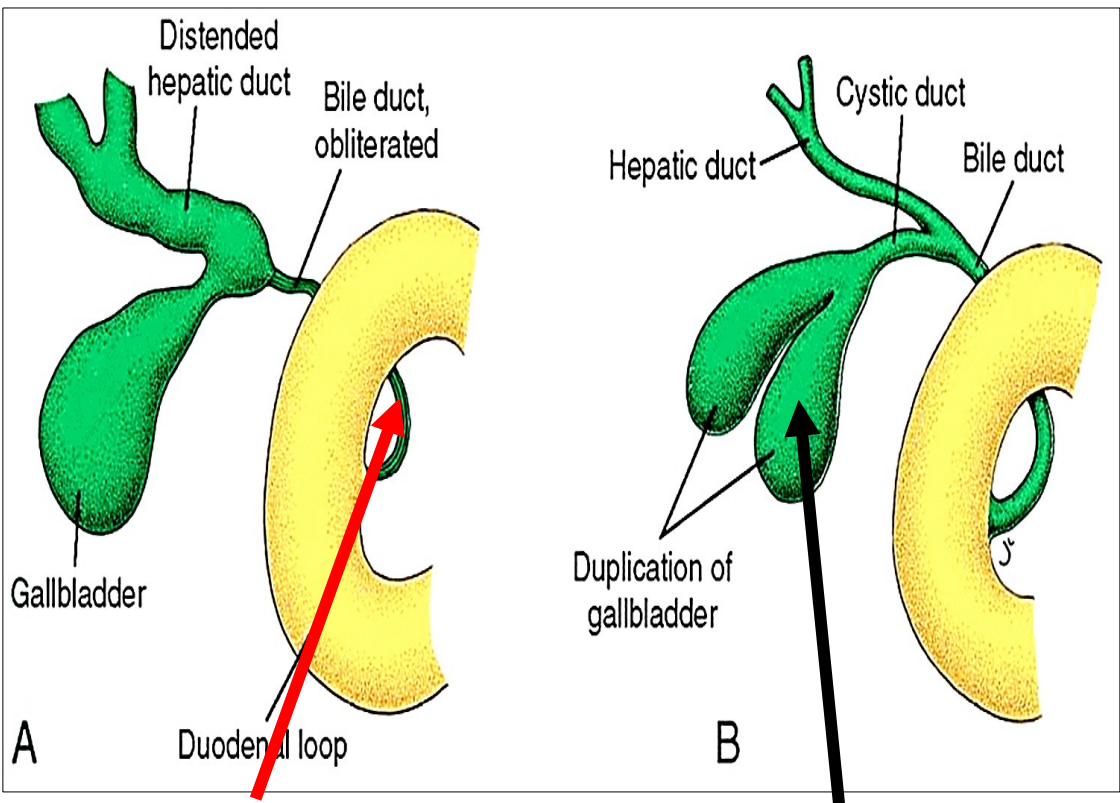
**.Being derived from foregut, the liver & gall bladder are supplied by hepatic artery from the **celiac trunk**.**



● **Anomalies of liver & biliary system:**

- 1. Agenesis of the gall bladder.**
- 2. Atresia of the common bile duct leading to jaundice.**
- 3. Bifid, double or intra-hepatic gall bladder.**
- 4. Variation in liver lobulation.**

# Anomalies of liver & biliary system



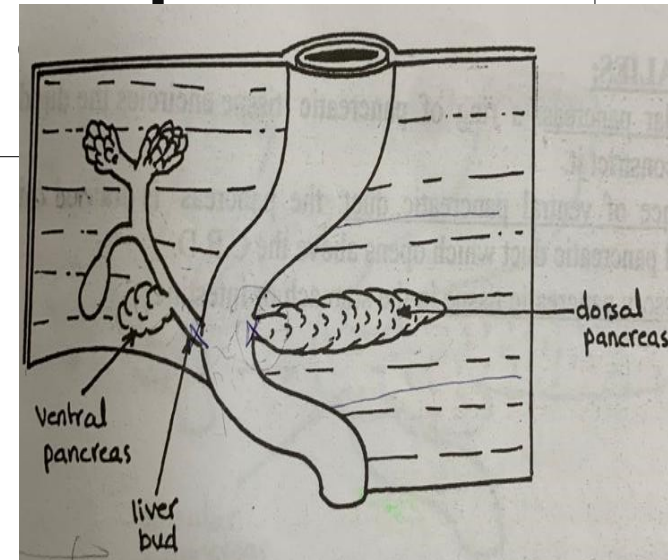
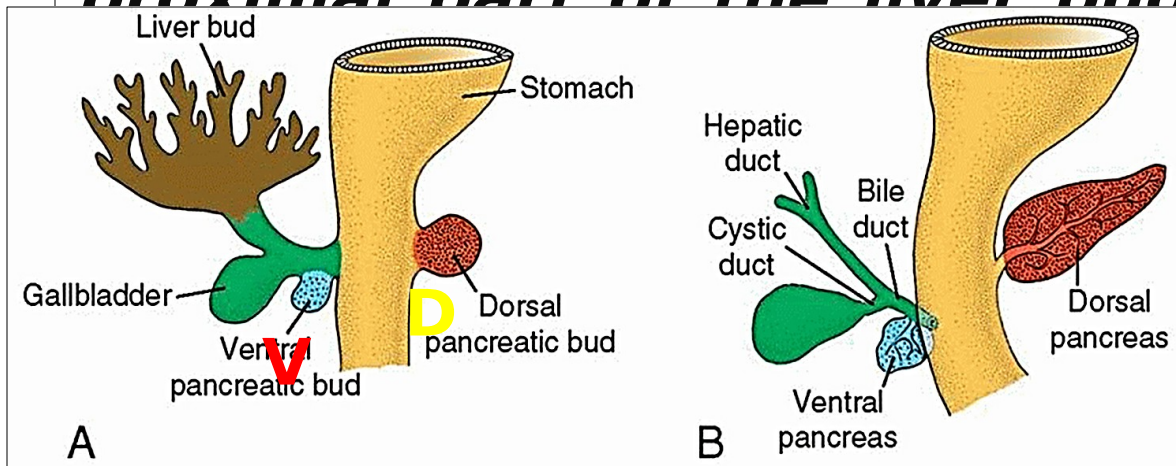
**Atresia of bile duct** **Double gall bladder** **Variation in liver lobulation**

## ● Development of pancreas:

-The pancreas develops from 2 endodermal sources: The dorsal **pancreatic bud** (*mainly*) & ventral **pancreatic bud**, which arise from the lower part of foregut.

-The dorsal pancreatic bud, which appears first, arises from the concavity of the duodenal loop just cranial to the hepatic bud & grows rapidly within the dorsal mesentery.

-The ventral pancreatic bud develops from the *proximal part of the liver bud*



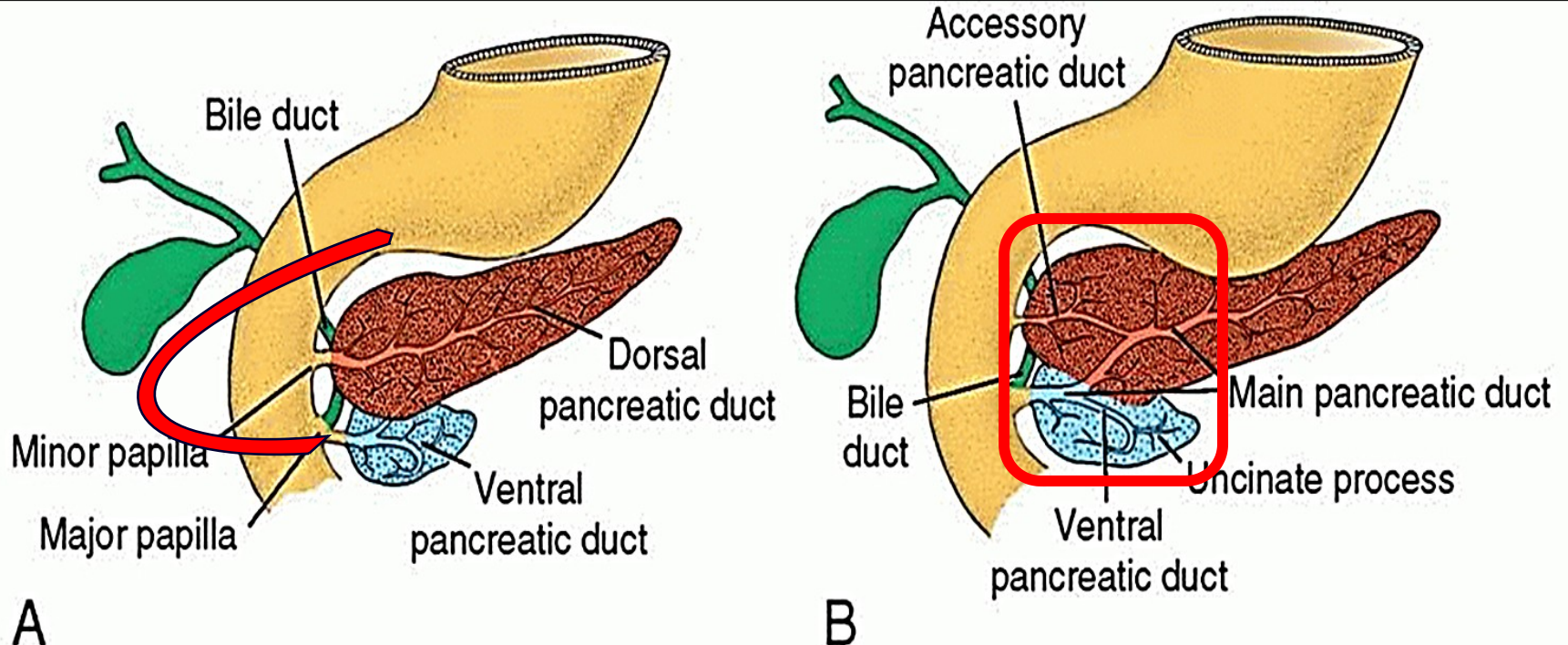


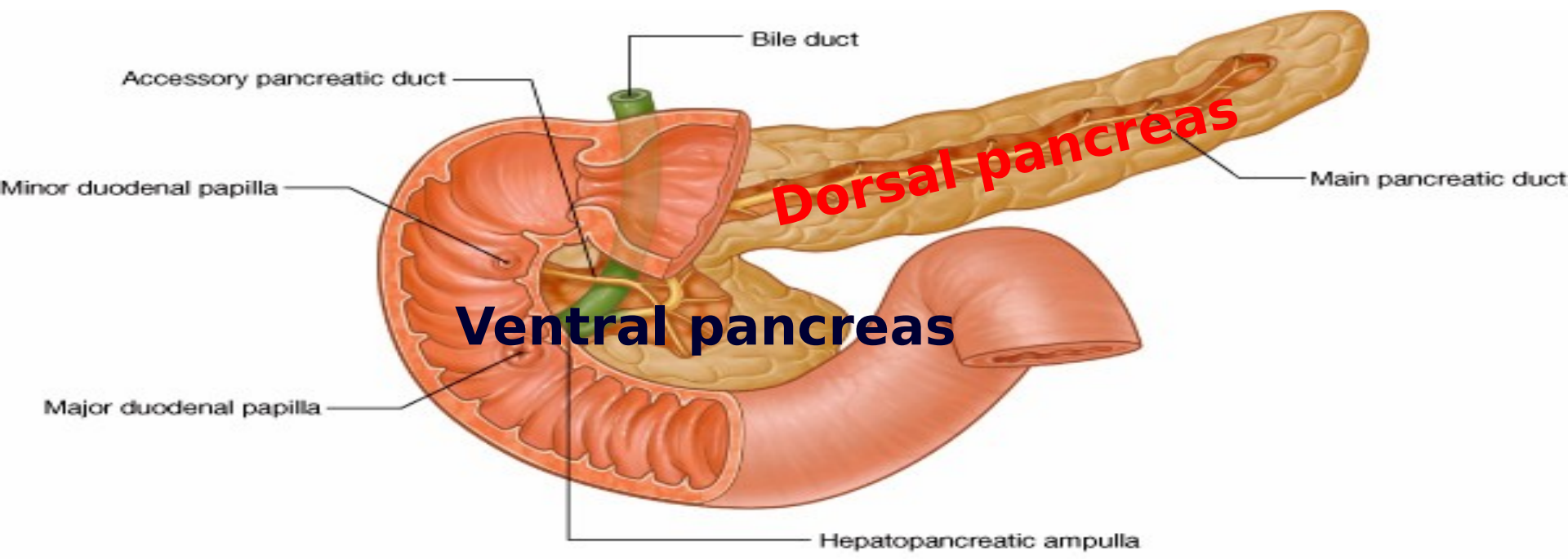
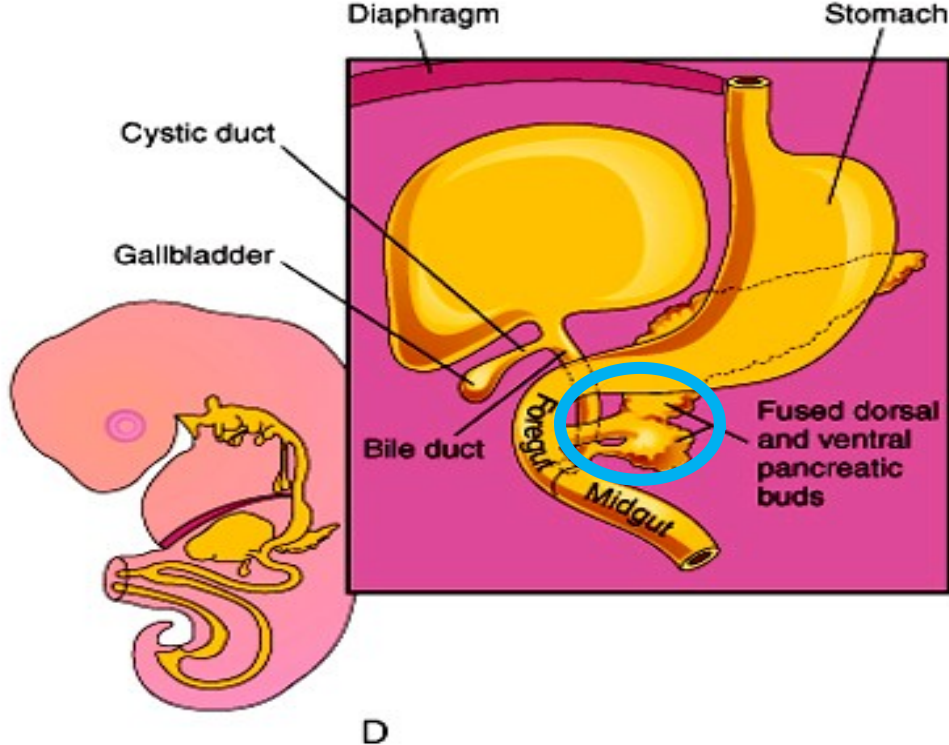
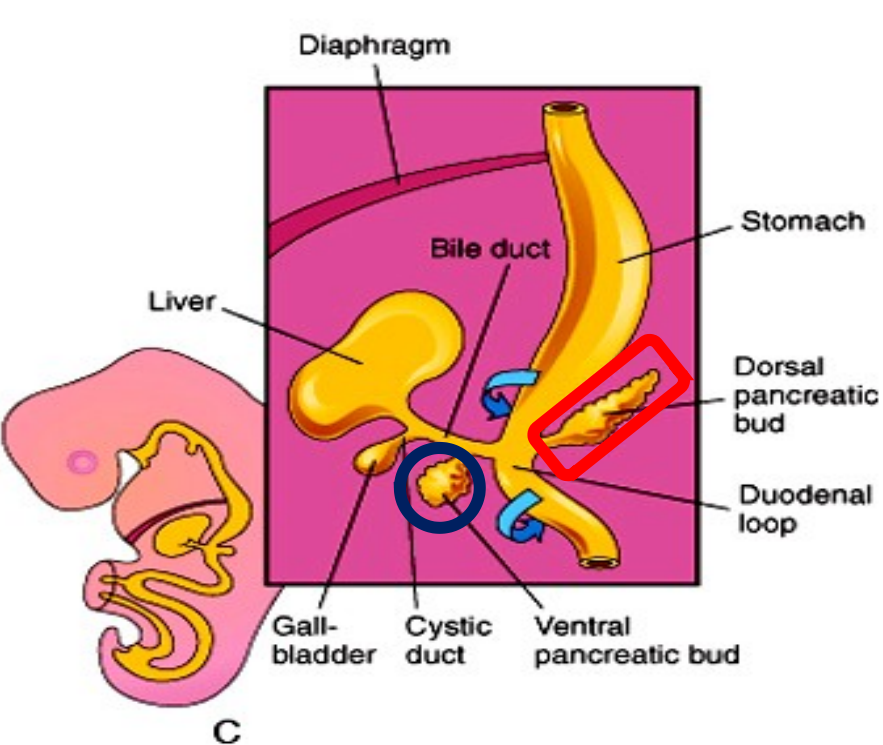
**.The ventral pancreas rotates around the right side of the duodenal loop to lie inferior to dorsal pancreas and fuses with it.**

**-Ventral pancreas ⇒ Lower part of the head + uncinete process.**

**-Dorsal pancreas ⇒ Most of the pancreas.**

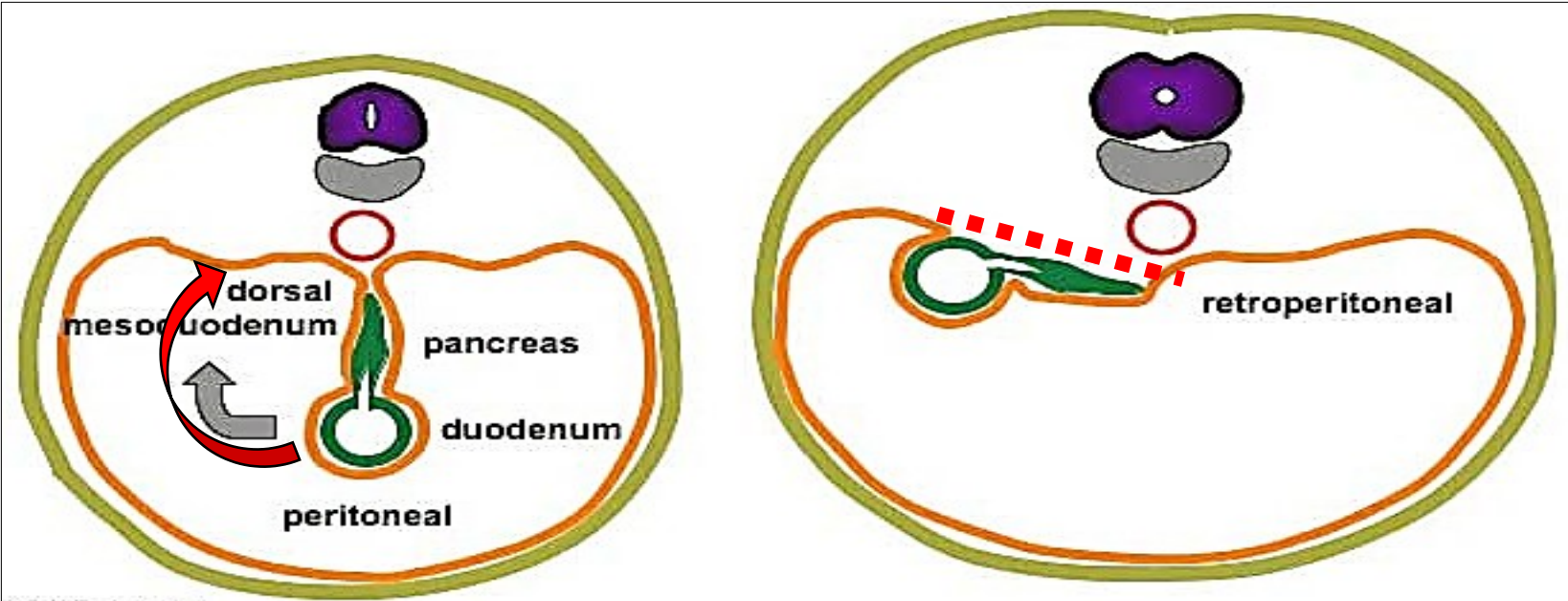
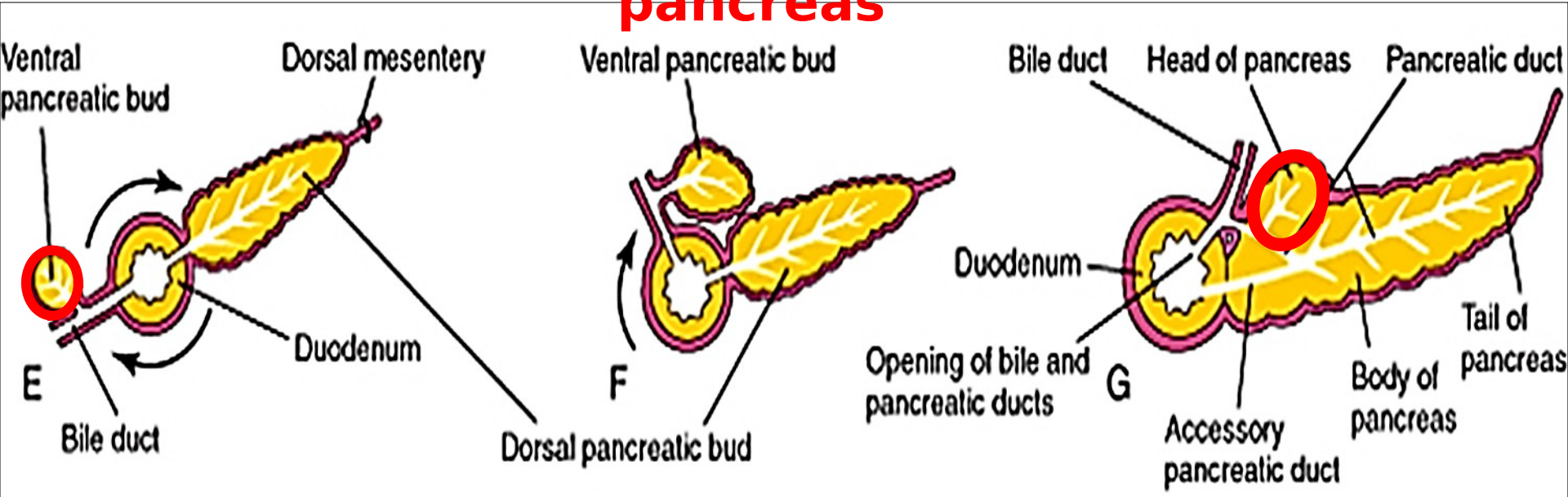
**•After rotation of duodenum & absorption of mesoduodenum, the pancreas becomes retro-**







# Rotation & fixation of the pancreas

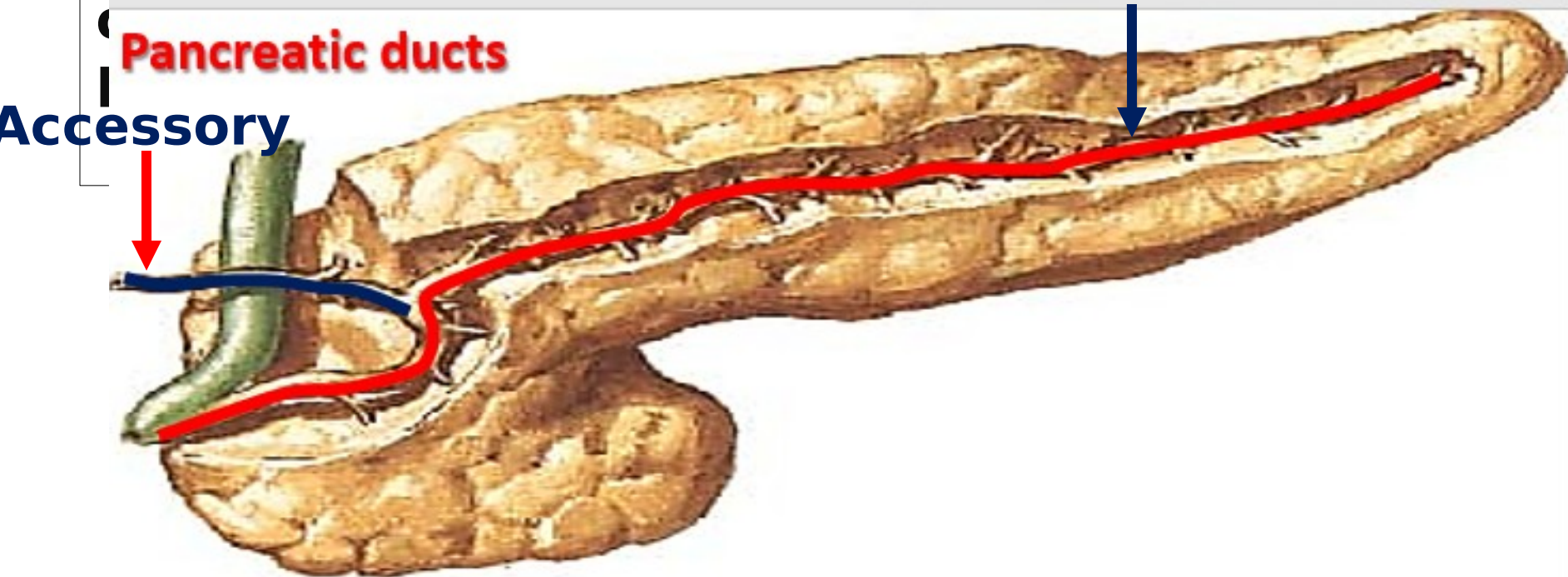


## ◆ **Pancreatic ducts:**

-As the pancreatic buds fuse, their ducts anastomose.

.**Main pancreatic duct** develops from the duct of the ventral bud & the distal part of the duct of the dorsal bud.

.The proximal part of the duct of the dorsal bud forms an **accessory pancreatic duct** that





• **Pancreatic acini arise as buds from the ducts. The islets of Langerhans arise in 3<sup>rd</sup> month also as buds from the ducts, but later they become disconnected from them (*Endodermal*).**

• **Insulin secretion begins in 5<sup>th</sup> months; therefore a diabetic pregnant woman needs less insulin afterwards.**

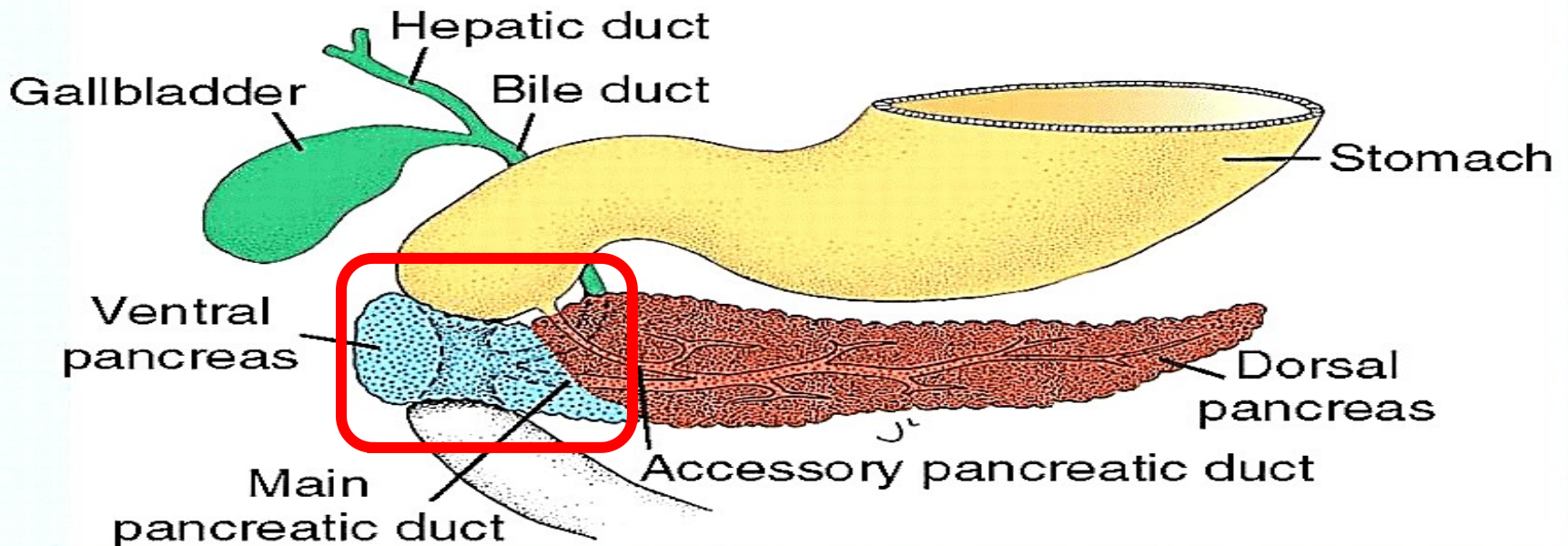
***-Stroma & capsule are mesodermal.***

## ● **Anomalies of pancreas:**

### **1. Annular pancreas:**

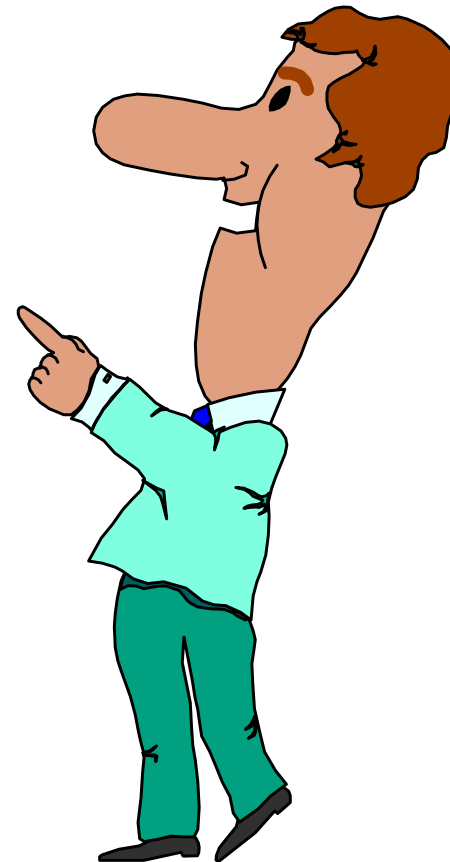
**.A ring-like band of pancreatic tissue surrounds the descending (2<sup>nd</sup>) part of the duodenum & may cause duodenal obstruction.**

**2. Accessory pancreatic tissue in the stomach or intestine.**





# QUIZ





■ Mention true or false for each statement regarding the development of duodenum, liver & biliary system and pancreas:

a. Duodenal loop develops completely from caudal part of the foregut.

b. Duodenal rotation results in posterior shift of bile duct opening.

c. Pars hepatica gives rise to hepatic stroma.

d. Common hepatic duct develops from stem of liver bud.

e. Accessory pancreatic duct develops from ventral pancreatic duct.

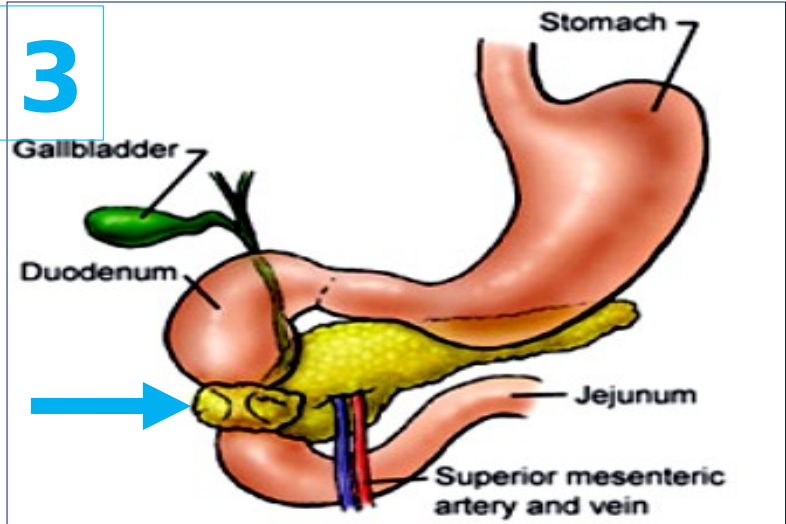
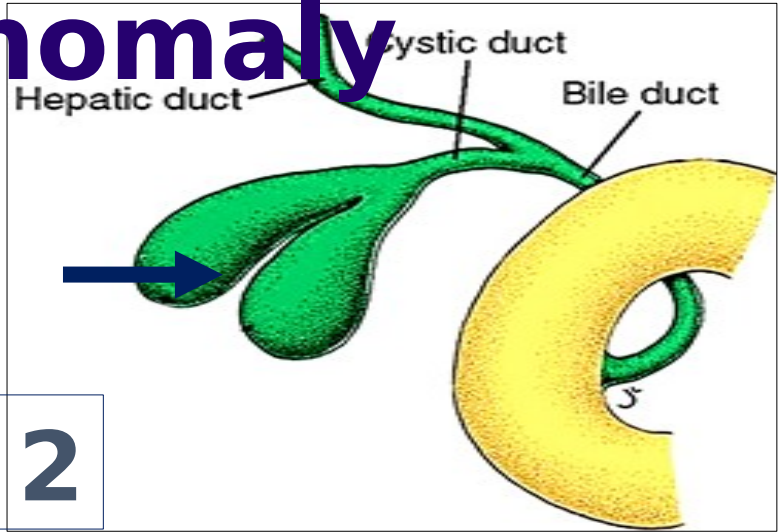
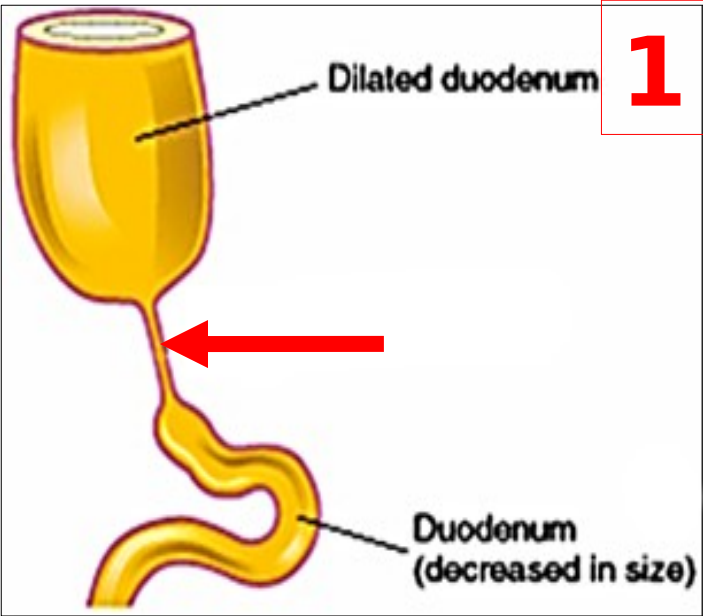
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■ Mention the primordia of the following structures:

**Bile duct - Hepatocytes - Gall bladder - Hepatic sinusoids - Uncinate process of pancreas.**



# Identify the anomaly



## References

- 1.Keith L. Moore: Before we are born, essentials of embryology and birth defects; 7<sup>th</sup> edition.**
- 2.Langman: Medical embryology; 11<sup>th</sup> edition.**
- 3.Web site:  
[www.studentconsult.com](http://www.studentconsult.com)**

**GOOD LUCK**